Libby Asbestos Site
Operable Unit 3
Ecological Risk Assessment

October 30-31, 2007
EPA Region 8

Purpose of the meeting: To provide a forum for internal discussions leading to development of a proposed strategy for the ecological risk assessment including a draft problem formulation and selection of assessment and measurement endpoints, all for presentation/discussion in a Biological Technical Assistance Group (BTAG) meeting. The first meeting of the BTAG for OU3 is currently planned for November 2007.

Proposed Agenda:

October 30, 2007
1:00 PM – 5:00 PM

1. Tutorial on asbestos analytical methods
   -Mary Goldade, EPA Region 8

2. Overview of OU3, Summary of Existing Environmental Data
   -Bonnie Lavelle, EPA Region 8
   -Dan Wall, US Fish and Wildlife Service

3. Discussion of Conceptual Site Models (CSM) for Exposure of Ecological Receptors
   - CSM for exposure to asbestos
   - CSM for exposure to non-asbestos contaminants

4. Development of proposed strategy for assessing risks to mammals and birds (asbestos and non-asbestos contaminants)
   - Summary of literature
   - Assessment and measurement endpoints
   - Data Quality Objective Discussion?

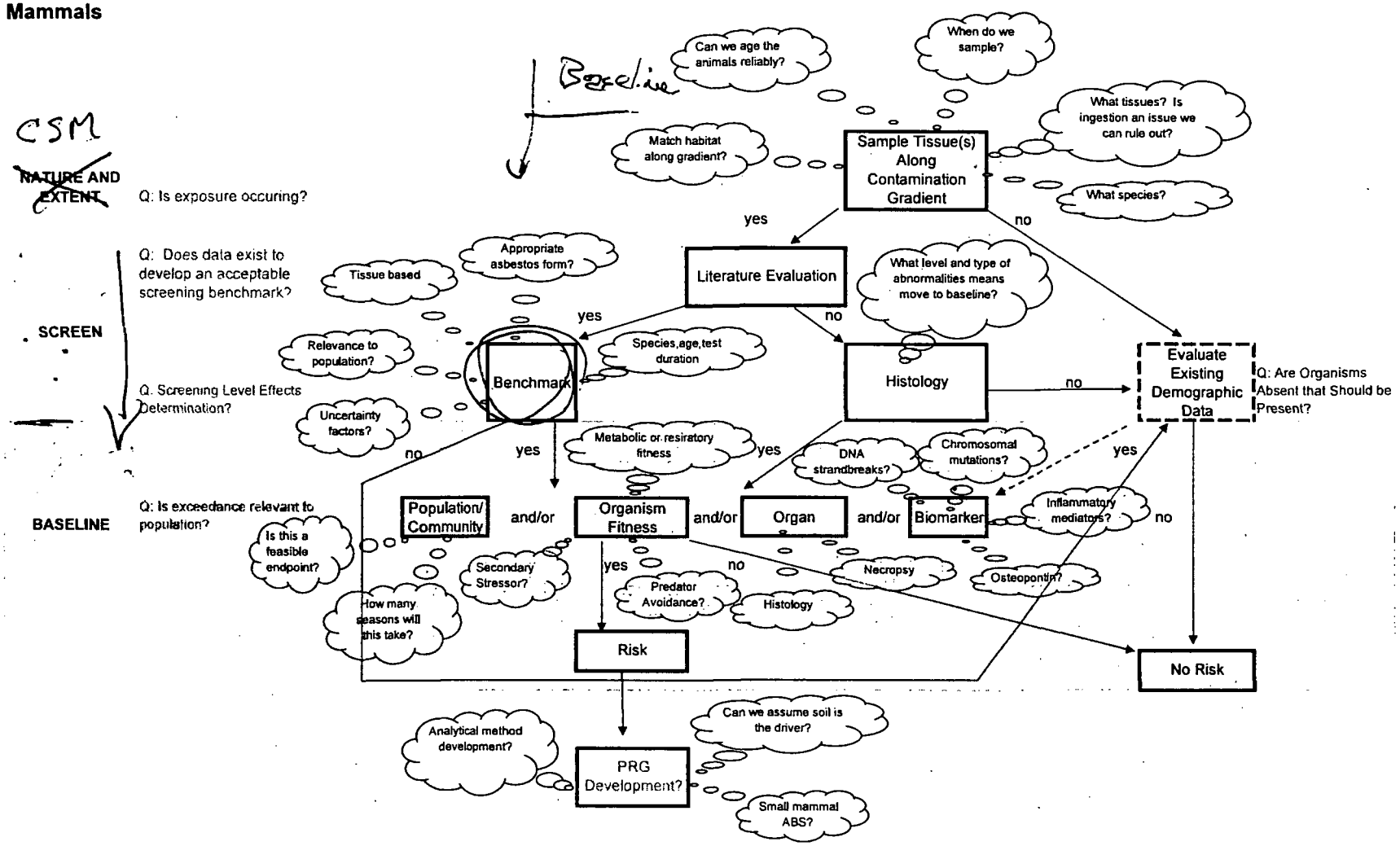
October 31, 2007
8:30 AM – Noon

1. Development of proposed strategy for assessing risks to aquatic receptors, soil invertebrates, and plants (asbestos and non-asbestos contaminants)
    - Summary of literature
    - Assessment and measurement endpoints
    - Data Quality Objective Discussion?

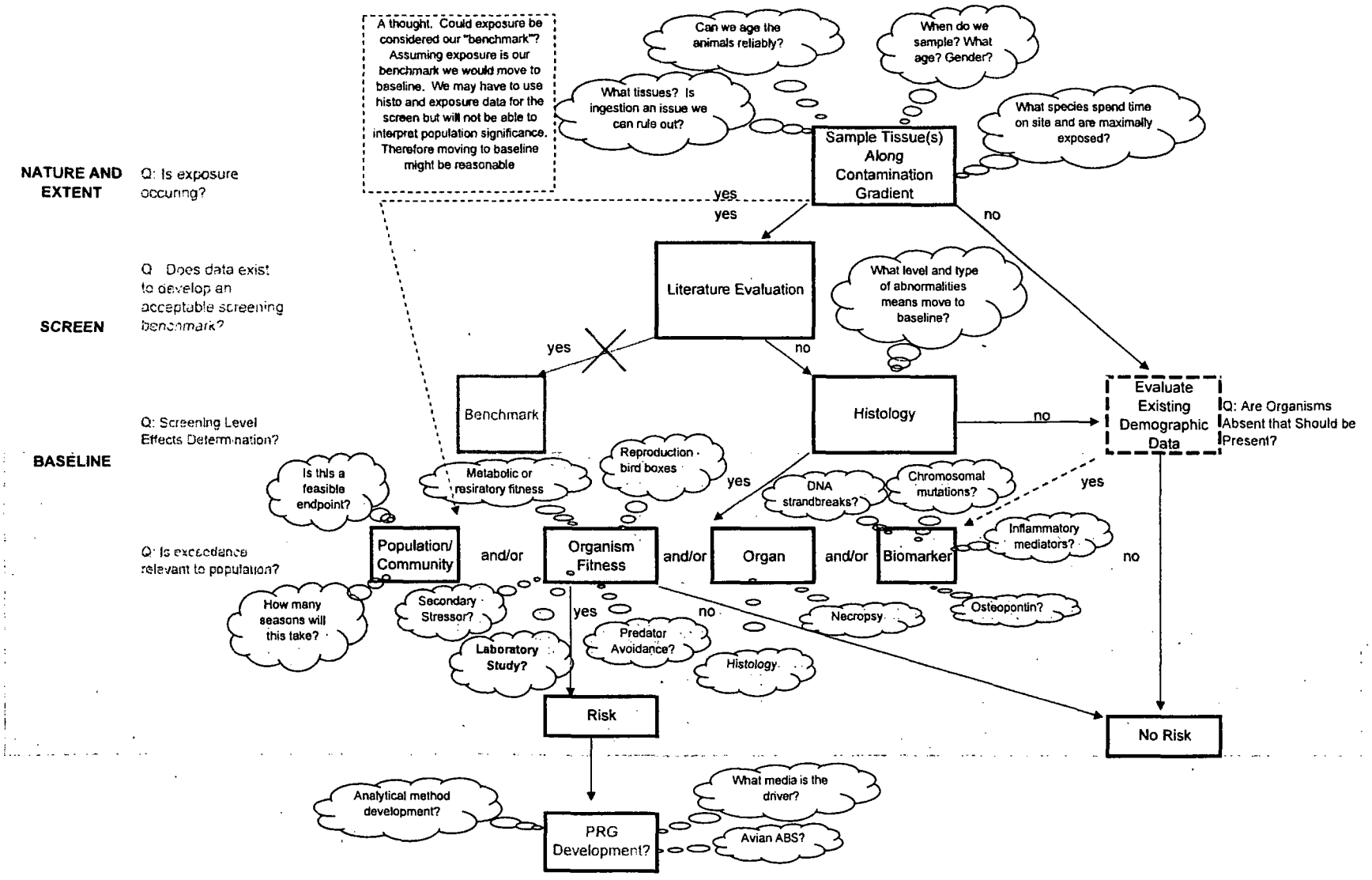
2. Development of BTAG meeting agenda

3. Action items to prepare for BTAG meeting

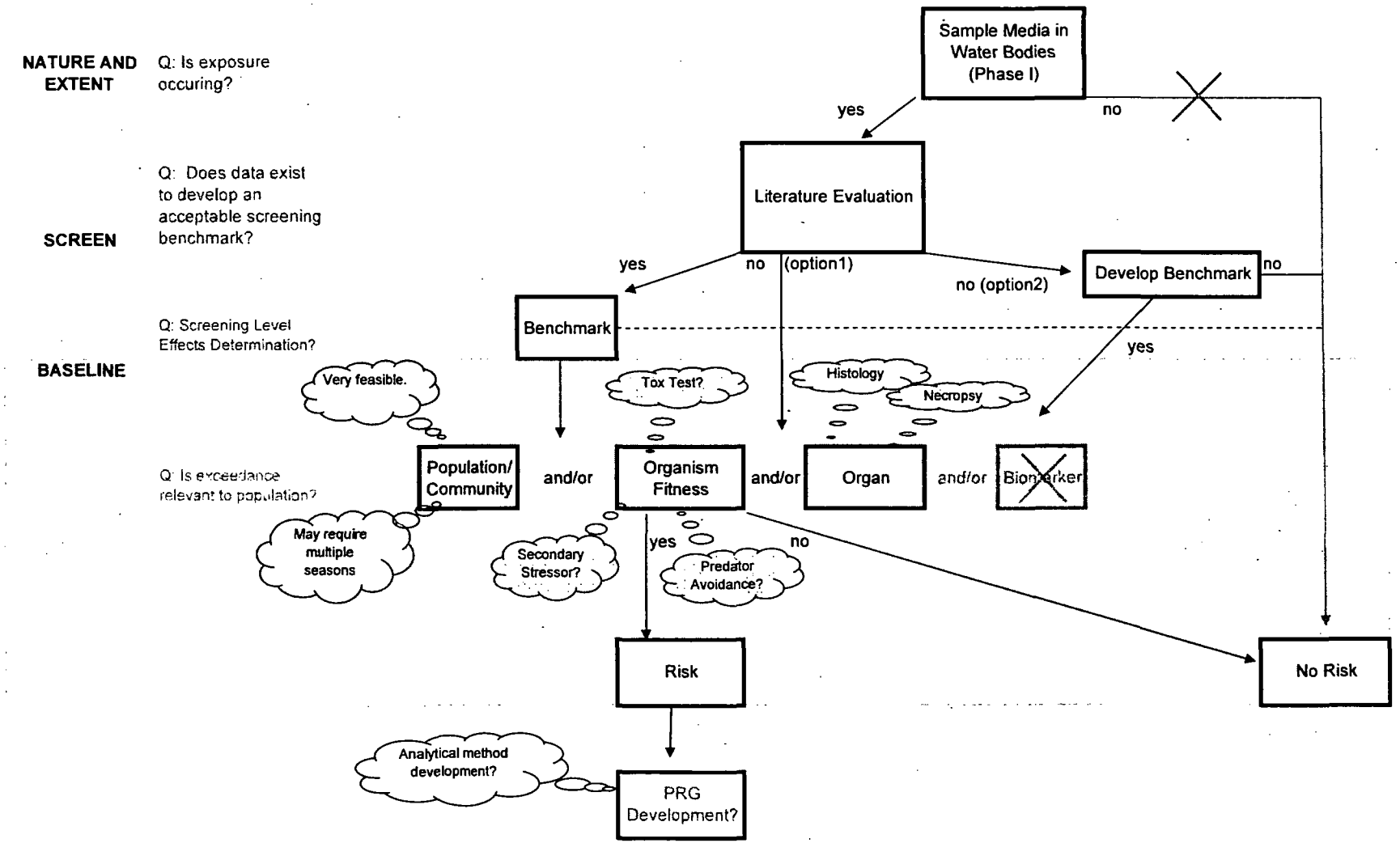
Mammals


CSM
NATURE AND EXTENT
Q: Is exposure occuring?
Q: Does data exist to develop an acceptable screening benchmark?
SCREEN
Q: Screening Level Effects Determination?
BASELINE
Q: Is exceedance relevant to population?
Baseline
Can we age the animals reliably?
When do we sample?
Match habitat along gradient?
Sample Tissue(s) Along Contamination Gradient
What tissues? Is ingestion an issue we can rule out?
What species?
yes
no
Literature Evaluation
Appropriate asbestos form?
Tissue based
What level and type of abnormalities means move to baseline?
yes
no
Relevance to population?
Benchmark
Species,age,test duration
Histology
no
Evaluate Existing Demographic Data
Q: Are Organisms Absent that Should be Present?
Uncertainty factors?
no
yes
Metabolic or resiratory fitness
yes
DNA strandbreaks?
Chromosomal mutations?
yes
Population/ Community
and/or
Organism Fitness
and/or
Organ
and/or
Biomarker
Inflammatory mediators?
no
Is this a feasible endpoint?
Secondary Stressor?
yes
no
Predator Avoidance?
Histology
Necropsy
Osteopontin?
How many seasons will this take?
Risk
No Risk
Analytical method development?
Can we assume soil is the driver?
PRG Development?
Small mammal ABS?

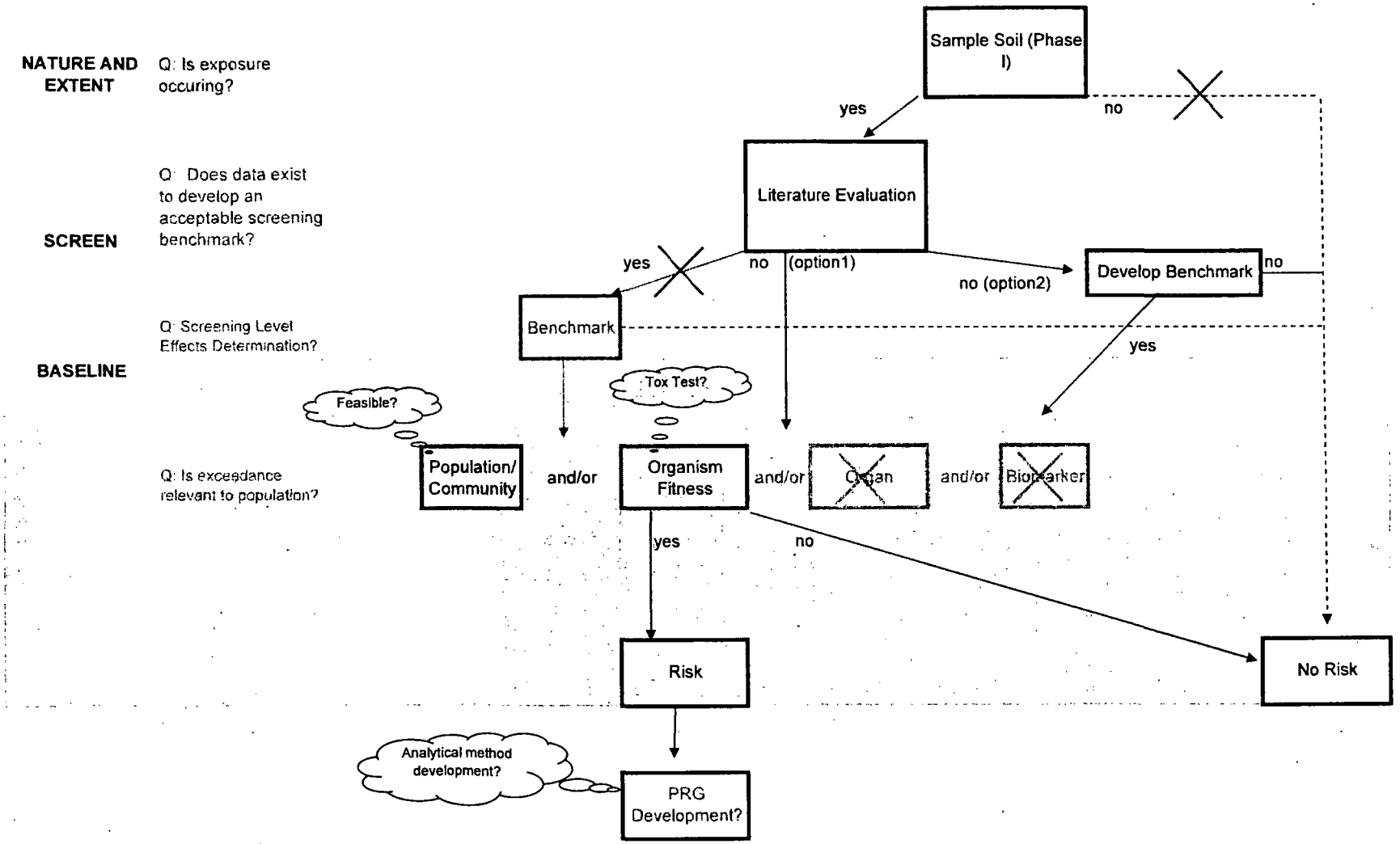
Birds


NATURE AND EXTENT
Q: Is exposure occuring?
SCREEN
Q Does data exist to develop an acceptable screening benchmark?
BASELINE
Q: Screening Level Effects Determination?
Q: Is exceedance relevant to population?
A thought. Could exposure be considered our "benchmark"? Assuming exposure is our benchmark we would move to baseline. We may have to use histo and exposure data for the screen but will not be able to interpret population significance. Therefore moving to baseline might be reasonable
Can we age the animals reliably?
When do we sample? What age? Gender?
What tissues? Is ingestion an issue we can rule out?
What species spend time on site and are maximally exposed?
Sample Tissue(s) Along Contamination Gradient
yes
yes
no
Literature Evaluation
What level and type of abnormalities means move to baseline?
yes
no
Benchmark
Histology
no
Evaluate Existing Demographic Data
Q: Are Organisms Absent that Should be Present?
Is this a feasible endpoint?
Metabolic or resiratory fitness
Reproduction - bird boxes
yes
DNA strandbreaks?
Chromosomal mutations?
yes
Inflammatory mediators?
no
Population/ Community
and/or
Organism Fitness
and/or
Organ
and/or
Biomarker
How many seasons will this take?
Secondary Stressor?
Laboratory Study?
yes
no
Predator Avoidance?
Histology
Necropsy
Osteopontin?
Risk
No Risk
Analytical method development?
What media is the driver?
PRG Development?
Avian ABS?

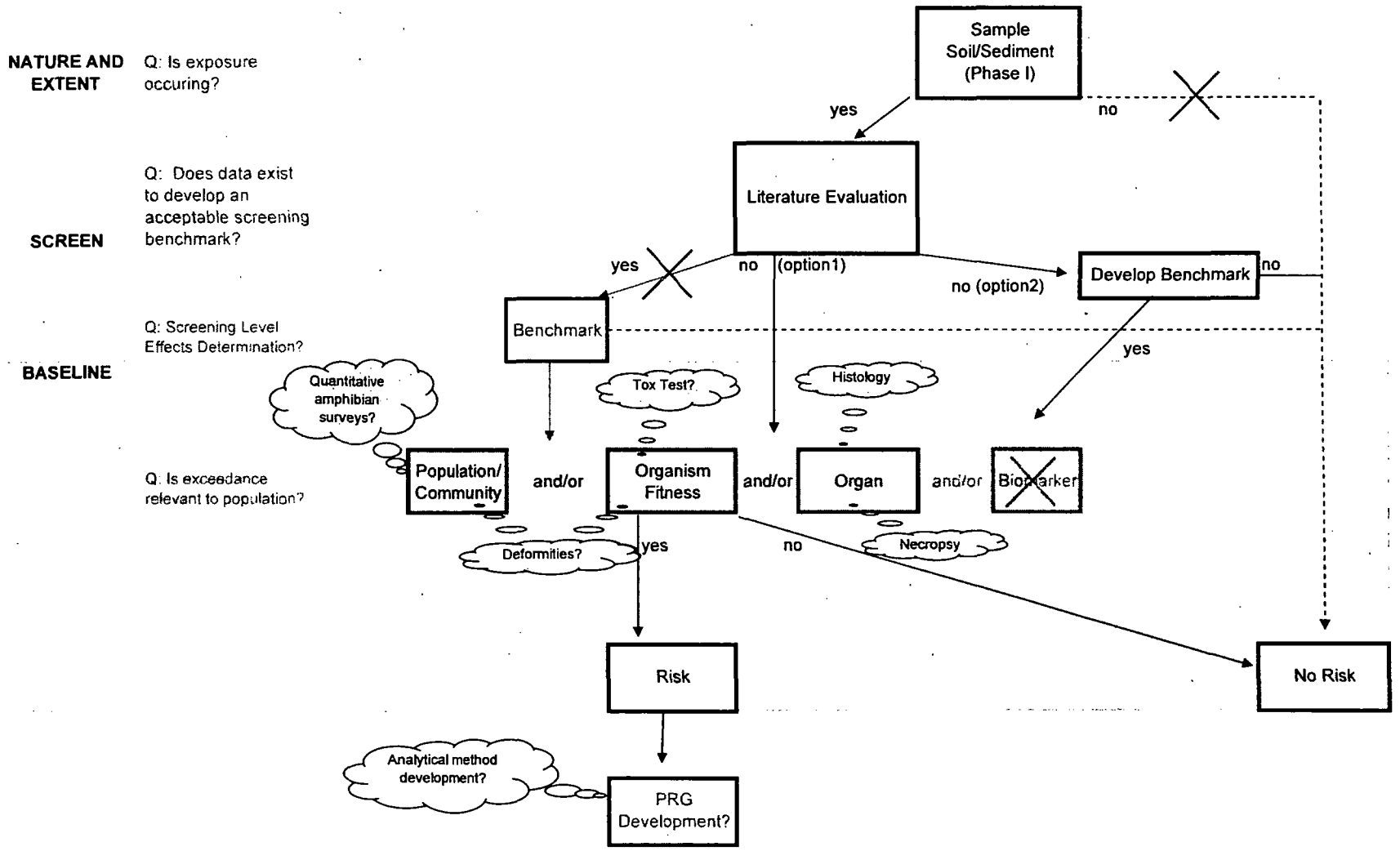
Aquatic


NATURE AND EXTENT
Q: Is exposure occuring?
Sample Media in Water Bodies (Phase I)
yes
no
SCREEN
Q: Does data exist to develop an acceptable screening benchmark?
Literature Evaluation
yes
no
(option1)
no (option2)
Develop Benchmark
no
Benchmark
BASELINE
Q: Screening Level Effects Determination?
yes
Very feasible.
Tox Test?
Histology
Necropsy
Q: Is exceedance relevant to population?
Population/ Community
and/or
Organism Fitness
and/or
Organ
and/or
Biomarker
May require multiple seasons
Secondary Stressor?
yes
no
Predator Avoidance?
Risk
No Risk
Analytical method development?
PRG Development?

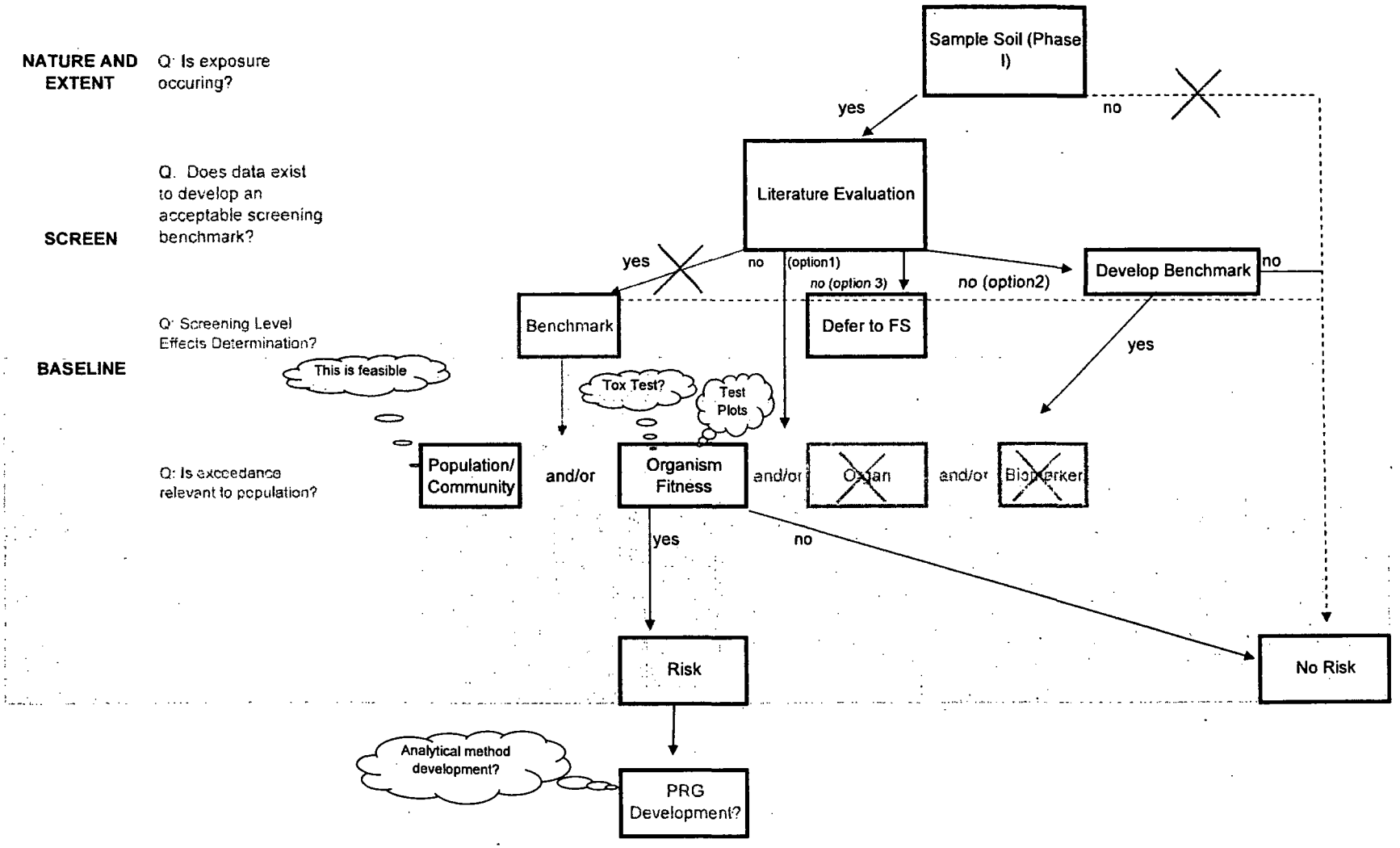
Terrestrial Invertebrate



Amphibian


NATURE AND EXTENT
Q: Is exposure occuring?
Sample Soil/Sediment (Phase I)
yes
no
SCREEN
Q: Does data exist to develop an acceptable screening benchmark?
Literature Evaluation
yes
no
(option1)
no (option2)
Develop Benchmark
no
Benchmark
yes
BASELINE
Q: Screening Level Effects Determination?
Quantitative amphibian surveys?
Tox Test?
Histology
Population/ Community
and/or
Organism Fitness
and/or
Organ
and/or
Biomarker
Q: Is exceedance relevant to population?
Deformities?
yes
no
Necropsy
Risk
No Risk
Analytical method development?
PRG Development?

Terrestrial Plants



Oct 30, 2007

Table 1. Literature Classification Categories		
Rejection Criteria	**Description**	**Useful for Derivation of Toxicity Value?**
ABSTRACT (Abstract)	Abstracts of journal publications or conference presentations	No
ACUTE STUDIES (Acu)	Single oral dose or exposure duration of three days or less.	No
ALTERED RECEPTOR (Alt)	Studies that describe the effects of the contaminant on surgically-altered or chemically-modified receptors (e.g., right nephrectomy, left renal artery ligature, hormone implant, etc.).	No
BIOMARKER (Biom)	Studies reporting results for a biomarker having no reported association with an adverse effect and an exposure dose (or concentration).	No
CHEMICAL METHODS (Chem Meth)	Studies reporting methods for determination of contaminants, purification of chemicals, etc. Studies describing the preparation and analysis of the contaminant in the tissues of the receptor.	No
CONFERENCE PROCEEDINGS (CP)	Studies reported in conference and symposium proceedings.	Yes
DEAD (Dead)	Studies reporting results for dead organisms. Studies. reporting field mortalities with necropsy data where it is not possible to establish the dose to the organism.	No
DISSERTATIONS (Diss)	Dissertations are excluded. However, dissertations should be flagged for possible future use.	Yes
DUPLICATE DATA (Dup)	Studies reporting results that are duplicated in a separate publication. The publication with the earlier year is used.	No
FOREIGN LANGUAGE (FL)	Studies in languages other than English	No
HUMAN HEALTH (HHE)	Studies with human subjects.	No
IN VITRO (In Vit)	*In vitro* studies, including exposure of cell cultures, excised tissues and/or excised organs.	No
METHODS (Meth)	Studies reporting methods or methods development without usable toxicity test results for specific endpoints.	No
MIXTURE (Mix)	Studies that report data for combinations of single toxicants (e.g. asbestos and cadmium) are excluded. Exposure in a field setting from contaminated natural soils or waste application to soil may be coded as Field Survey.	No
MODELING (Model)	Studies reporting the use of existing data for modeling, i.e., no new organism toxicity data are reported. Studies which extrapolate effects based on known relationships between parameters and adverse effects.	No
NO CONTAMINANT OF CONCERN (No COC)	Studies that do not examine the toxicity of asbestos	No
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NO DOSE or CONC (No Dose)	Studies with no usable dose or concentration reported. These are usually identified after examination of full paper. This includes studies which examine effects after exposure to contaminant ceases. This also includes studies where offspring are exposed in utero and/or during lactation and then after weaning to similar concentrations (or doses) as their parents. Dose cannot be determined. In some cases, where exposure was during gestation and effects are measured after cessation of exposure (after birth), data are retained to record reproductive latent effects. This includes studies where the organisms are replaced or replenished during the study.	No
NO DURATION (No Dur)	Studies with no exposure duration. These are usually identified after examination of full paper.	No
NO EFFECT (No Efct)	Studies with no relevant effect evaluated in a biological test species or data not reported for effect discussed.	No
NO EXPOSURE (No Exp)	Studies without a relevant route of exposure including intrapleural injection, intraperitoneal injection, other injections, and dermal exposures.	No
NO ORGANISM (No Org)	Studies that do not examine or test a viable organism (also see in vitro rejection category).	No
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	No
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	No
NUTRIENT DEFICIENCY (Nut def)	Studies of the effects of nutrient deficiencies. Nutritional deficient diet is identified by the author. If reviewer is uncertain then the administrator should be consulted. Effects associated with added nutrients are coded.	No
PHYSIOLOGY STUDIES (Phys)	Physiology studies where adverse effects are not associated with exposure to contaminants of concern. Papers that examine the physiology of a receptor type	No
PRIMATE (Prim)	Toxicity studies on primates	No
PUBL AS (Publ as)	The author states that the information in this report has been published in another source. Data are recorded from only one source. The secondary citation is noted as Publ As.	No
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SURVEY (Surv)	Studies reporting the toxicity of a contaminant in the field over a period of time. Often neither a duration nor an exposure concentration is reported.	Maybe
UNRELATED (Unrel)	Studies that are unrelated to asbestos exposure and response and/or the receptor groups of interest.	No

Oct 30, 2007

Literature Search

- Toxline
- Duluth holdings
- BIOSIS
- Web of Science
- Manual review
- 6,395 records to date

Classification by Receptor

- Mammal
- *Bird*
- Terrestrial Plant
- Terrestrial Invertebrate
- Human
- Primate
- Fish
- Aquatic Invertebrate
- Multiple
- None

Mammalian Studies

- Species:
  - laboratory rodents (rat, mouse, hampster)
- Exposure Routes:
  - Gavage (GV)
  - Diet (FD)
  - Drinking Water (DR)
  - Inhalation (IN)
    - Aerosol Nose Only
    - Inhalation chambers
- Exposure Units:
  - Mass/org/d
  - Fibers/L
  - % of diet
  - f/cc
  - others
- Asbestos forms:
  - chrysotile,
  - amosite,
  - crocidolite
- Exposure Duration:
  - acute (3 days or less)
  - Single
  - Chronic
  - Lifetime
- Lifestage
  - Juvenile
  - Gestational
  - Not Reported (NR)

Endpoints

- Reproduction (REP)
  - Offspring survival, weight
  - Litter size
- Growth (GRO)
  - Changes in body weight
- Pathology (PTH)
  - Histology
  - Tumor incidence
  - Organ weight
- Mortality (MOR)
  - Mortality
  - Longevity
- Physiology (PHY)
  - Intestinal permeability
  - Kidney function
- Accumulation (ACC)
  - In organs
  - In offspring
- Biochemical (BIO)
  - Biochemical changes at cellular level
  - Chemical changes in blood or other response sites

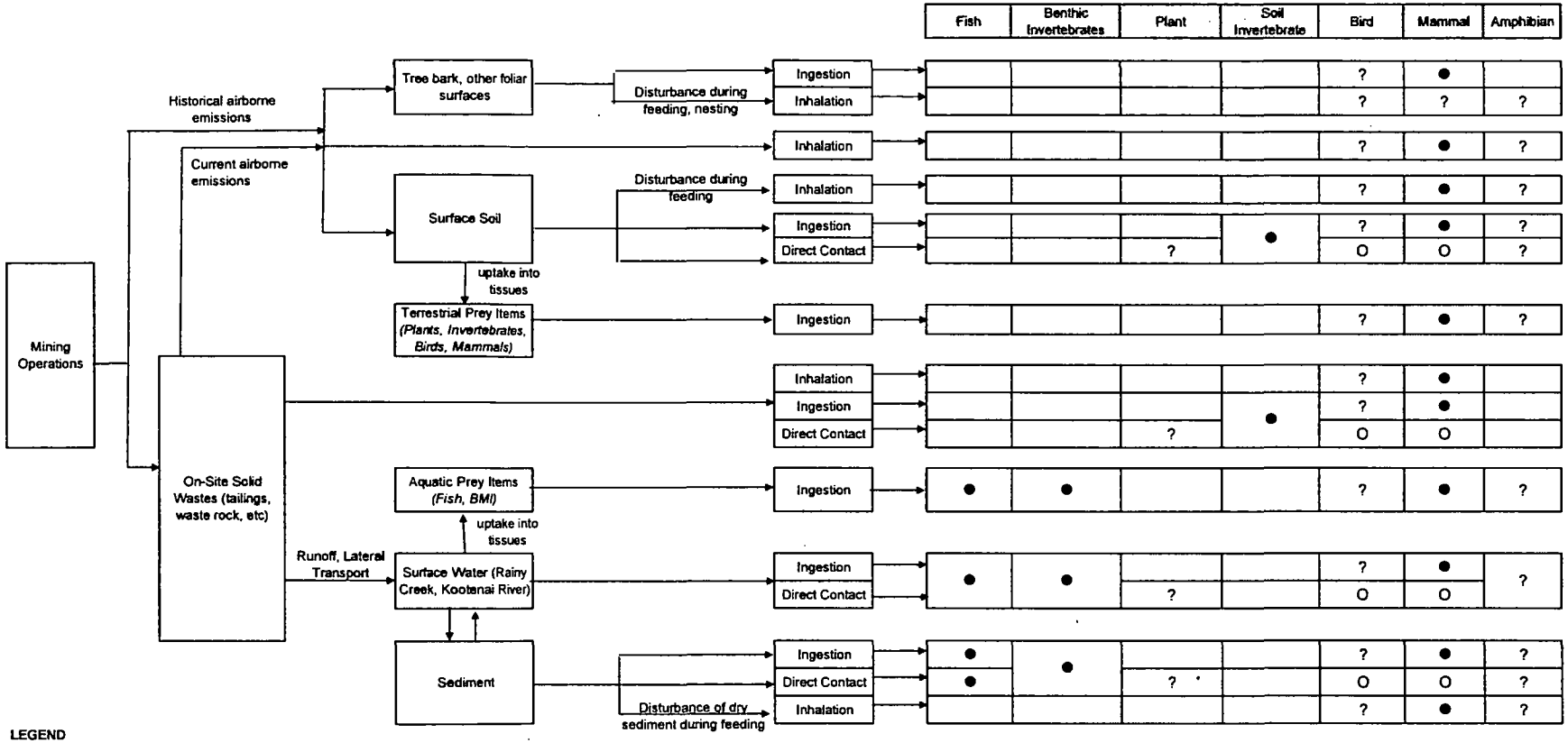
Avian Studies

Summary of Assessment and Measurement Endpoints
Asbestos
Libby Asbestos Site OU3

Receptor	Assessment Endpoint	Measurement Endpoint	Possible?
Aquatic Community	Protection of aquatic invertebrates and fish from adverse effects related to exposure to chemicals in surface water and sediment.	Comparison of sampling location-specific asbestos concentrations in surface water to toxicity benchmarks for invertebrates.	Yes. but data are limited to two species for Chyrsotile and one species for Crocidolite.
		Comparison of sampling location-specific asbestos concentrations in surface water to toxicity benchmarks for fish.	Yes. but data are limited to only Chyrsotile
		Comparison of sampling location-specific asbestos concentrations in sediment to toxicity benchmarks (fish, invertebrates and amphibians).	No. No toxicity data
		Evaluate the toxicity of site sediments to standard test organismsthrough laboratory testing.	Yes.
		Comparison of asbestos concentrations in food items (aquatic invertebrates) to dietary toxicity benchmarks for fish.	No. No toxicity data
		Benthic macroinvertebrate community structure, including density and diversity (taxa richness) of benthic organisms	Yes.
		Fish community structure including density and diversity.	Yes.
		Examination of fish for histopathology (effects associated with asbestos exposure)	Yes.
		Comparison of asbestos concentrations in fish tissue to maximum allowable tissue concentration (MATC) toxicity benchmarks for fish.	Maybe.
Terrestrial Community	Protection of terrestrial plants and terrestrial soil invertebrates from adverse effects related to exposure to chemicals in surface soil.	Comparison of sampling location-specific asbestos concentrations in soil to toxicity benchmarks.	No. No toxicity data
		Evaluate the toxicity of site soils to standard test organisms through laboratory testing.	Yes.
		Plant and/or soil invertebrate community structure	Yes.
Wildlife Community	Protection of wildlife from adverse effects to growth, reproduction, or survival related to exposure to asbestos in air, surface water, sediment, soil, and food.	Comparison of the asbestos doses estimated from exposure point concentrations (EPCs) in air, surface water, sediment, soil, and food items to toxicity reference values (TRVs) for mammals.	Maybe.
		Comparison of the asbestos doses estimated from exposure point concentrations (EPCs) in air, surface water, sediment, soil, and food items to toxicity reference values (TRVs) for birds.	No. No toxicity data
		Examination of small mammals and birds for histopathology (effects associated with asbestos exposure)	Yes.
		Comparison of asbestos concentrations in mammal tissue to maximum allowable tissue concentration (MATC) toxicity benchmarks.	No. No toxicity data
		Comparison of asbestos concentrations in bird tissue to maximum allowable tissue concentration (MATC) toxicity benchmarks.	No. No toxicity data

Figure 4-3. Conceptual Site Model for Ecological Exposure to Asbestos

Operable Unit 3, Libby Superfund Site, Libby, Montana

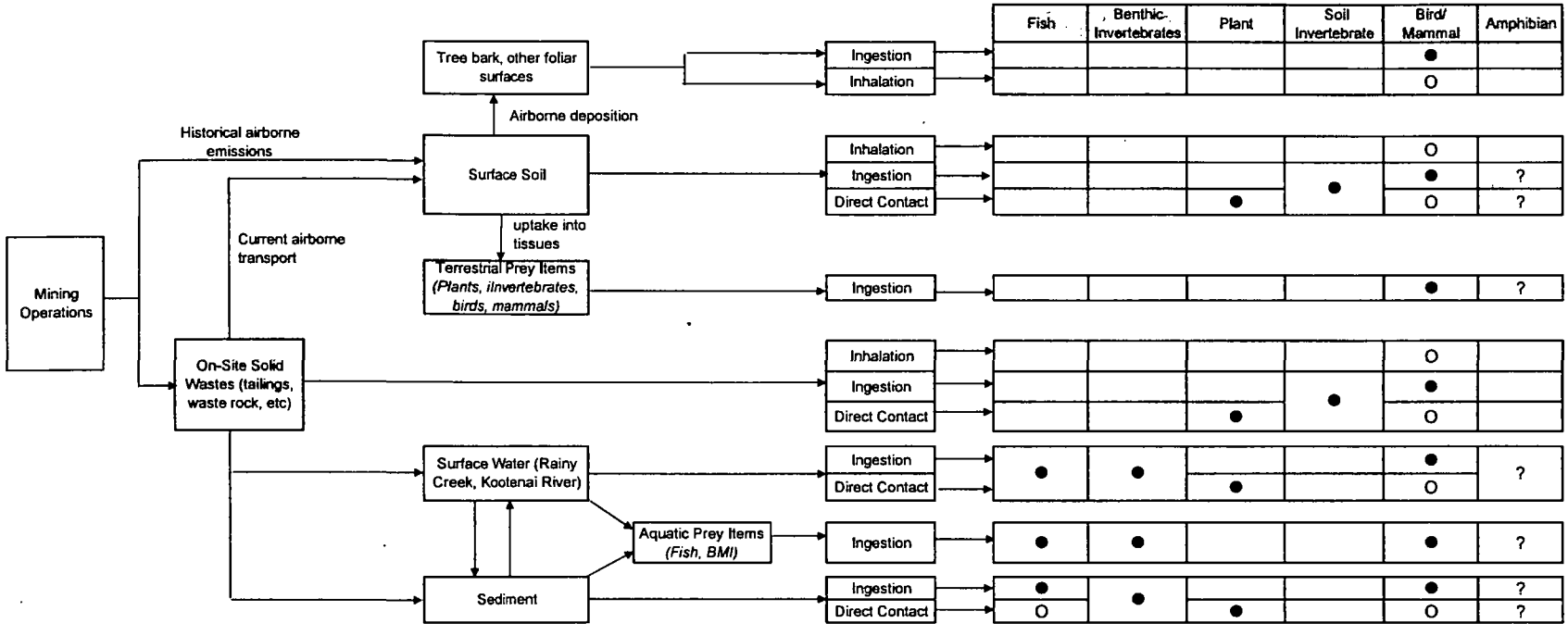


LEGEND

●	Pathway is believed to be complete, and which may provide an important contribution to the total risk to the receptor. This pathway will be evaluated using one or more lines of evidence.
O	Pathway is believed to be complete but is unlikely to be a major contributor to the total risk to the receptor (in comparison to one or more other pathways that are evaluated). This pathway will not be evaluated quantitatively.
	Pathway is incomplete or believed to be negligible; further evaluation is not warranted
?	Pathway that is or might be complete, but current data are not adequate to decide if it is a significant contributor to the total risk of the receptor.

Figure 4-4. Conceptual Site Model for Ecological Exposure to Non-Asbestos Contaminants

Operable Unit 3, Libby Superfund Site, Libby, Montana



LEGEND

●	Pathway is believed to be complete, and which may provide an important contribution to the total risk to the receptor. Quantitative evaluation will be performed using one or more lines of evidence.
O	Pathway is believed to be complete but is unlikely to be a major contributor to the total risk to the receptor (in comparison to one or more other pathways that are evaluated). Pathway will not be evaluated quantitatively.
	Pathway is not believed to be occurring (now or in the future). This pathway is not evaluated.
?	Pathway that is or might be complete, but data are not adequate to decide if it is a major contributor to the total risk of the receptor.

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NO EXPOSURE (No Exp)	Studies without a relevant route of exposure including intrapleural injection, intraperitoneal injection, other injections, and dermal exposures.	No
NO ORGANISM (No Org)	Studies that do not examine or test a viable organism (also see in vitro rejection category).	No
NOT AVAILABLE (Not Avail)	Papers that could not be located. Citation from electronic searches may be incorrect or the source is not readily available.	No
NOT PRIMARY (Not Prim)	Papers that are not the original compilation and/or publication of the experimental data.	No
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UNRELATED (Unrel)	Studies that are unrelated to asbestos exposure and response and/or the receptor groups of interest.	No

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Classification by Receptor

- Mammal
- Bird
- Terrestrial Plant
- Terrestrial Invertebrate
- Human
- Primate
- Fish
- Aquatic Invertebrate
- Multiple
- None

Mammalian Studies

- Species:
  - laboratory rodents (rat, mouse, hampster)
- Exposure Routes:
  - Gavage (GV)
  - Diet (FD)
  - Drinking Water (DR)
  - Inhalation (IN)
    - Aerosol Nose Only
    - Inhalation chambers
- Exposure Units:
  - Mass/org/d
  - Fibers/L
  - % of diet
  - f/cc
  - others
- Asbestos forms:
  - chrysotile,
  - amosite,
  - crocidolite
- Exposure Duration:
  - acute (3 days or less)
  - Single
  - Chronic
  - Lifetime
- Lifestage
  - Juvenile
  - Gestational
  - Not Reported (NR)

Endpoints

- Reproduction (REP)
  - Offspring survival, weight
  - Litter size
- Growth (GRO)
  - Changes in body weight
- Pathology (PTH)
  - Histology
  - Tumor incidence
  - Organ weight
- Mortality (MOR)
  - Mortality
  - Longevity
- Physiology (PHY)
  - Intestinal permeability
  - Kidney function
- Accumulation (ACC)
  - In organs
  - In offspring
- Biochemical (BIO)
  - Biochemical changes at cellular level
  - Chemical changes in blood or other response sites

Avian Studies

Table 3-1
Asbestos Results for Soil Samples within OU3

Location	Sampling Date	Sample Description	PLM NIOSH 9002 Analytical Results Tremolite-Actinolite Area Fraction (%)
Rainy Creek Rd	12/11/99 - 12/12/99	52 surface (0-6") along the road	20 samples were non-detect; 30 samples were <1%; 2 samples with detectable levels ranging from 3% to 5%
	9/8/00	5 surface (0-6") from driveway	2 samples were non-detect; 1 sample was <1%; 2 samples with detectable levels at 2%
	4/5/01 - 4/6/01	9 surface (0-6") 5 sub-surface (6-12") 17 sub-surface (12"+)	4 samples were non-detect; 16 samples were <1%; 11 samples with detectable levels ranging from 2% to 8%
	10/9/01	4 surface (0-6") from the ampitheater	4 samples with detectable levels ranging from 2% to 7%
Forest Service Rd	7/17/03 - 7/22/03	4 surface (0-6")	4 samples were non-detect
Highway 37 N (Right of Way)	9/16/03 - 9/18/03	48 surface (0-6") *	8 samples were non-detect; 37 samples with trace levels; 3 samples were <1%
	5/23/05	12 surface (0-6")	1 sample was non-detect; 11 samples were <1%
	7/11/05	1 surface (0-6")	1 sample was non-detect
Carney Creek Logging Area	3/9/00	15 surface (0-6")	3 samples were non-detect; 11 samples were <1%; 1 sample with detectable levels at 1%
USFS Logging Site Above Ampitheater	3/10/00	5 surface (0-6")	5 samples were <1%

* Results based on PLM-VE mass fraction (%)

Based on samples in Libby2DB designated as OU3 (download date: July 5, 2007).

TABLE 3-2
SURFACE WATER ASBESTOS RESULTS IN THE LIBBY 2 DATABASE

Sample Date	Sample ID	Location Description	Analysis Date	Sensitivity $(ml)^{-1}$	LA Structures > 10 um		Total LA Structures	
					Count	Conc (s/mL)	Count	Conc (s/mL)
8/13/2001	1R-05337	Rainy Creek (Upper Reach) above upper pond	8/15/2001	104	**0**	**< 104**	**0**	**< 104**
	1R-05339	Zonolite Mountain -- Sleuce gate structure @ upper tailings pond	8/15/2001	207	**0**	**< 207**	**0**	**< 207**
	1R-06024	Zonolite Mountain -- Lower tailings pond @ water intake	8/15/2001	1,036	**0**	**< 1036**	**0**	**< 1036**
	1R-06026	Zonolite Mountain -- "Darwin Spring" @ upper decon	8/15/2001	104	**0**	**< 104**	**0**	**< 104**
	1R-06027	Rainy Creek (Lower Reach) catch basin	8/15/2001	414	**18**	**7,459**	**18**	**7,459**
5/16/2003	CS-11785	Zonolite Mountain -- Main discharge from upper tailings pond	5/20/2003	219	**0**	**< 219**	**1**	**219**
	CS-11786	Zonolite Mountain -- Confluence from discharge of upper tailings pond	5/20/2003	219	**0**	**< 219**	**1**	**219**
	CS-11787	Zonolite Mountain -- Stream located above lower tailings pond	5/20/2003	219	**3**	**658**	**43**	**9,438**
	CS-11788	Zonolite Mountain -- Main discharge from lower tailings pond	5/21/2003	439	**3**	**1,317**	**16**	**7,024**

Based on Libby 2DB download performed 7/5/07

TABLE 3-3
Non-Asbestos Results for Surface Water Samples in the Libby 2 Database

INDEX ID	SAMPLE DATE	SAMPLE LOCATION DESCRIPTION
1R-05329	2-Aug-01	Rainy Creek Rd, Vermiculite Mine -- Lower pond
1R-05330	2-Aug-01	Rainy Creek Rd, Vermiculite Mine -- Upper pond

INDEX ID		**1R-05329**	**1R-05330**
LAB SAMPLE ID		912533-001	912533-002
PARAMETER	UNITS		
INORGANICS			
Antimony	ug/L	<50	<50
Arsenic	ug/L	<5	<5
Beryllium	ug/L	<10	<10
Cadmium	ug/L	<5	<5
Chromium	ug/L	<10	<10
Copper	ug/L	< 10	< 10
Lead	ug/L	< 50	< 50
Mercury	ug/L	< 0.5	< 0.5
Nickel	ug/L	< 25	< 25
Selenium	ug/L	< 5	< 5
Silver	ug/L	< 10	< 10
Thallium	ug/L	< 5	< 5
Zinc	ug/L	< 50	< 50
Cyanide, total	mg/L	< 0.01	< 0.01
TOTAL PETROLEUM HYDROCARBONS (TPH)			
TPH-DIESEL	ug/L	< 100	< 100
TPH-GASOLINE	ug/L	< 100	< 100
RGANOCHLORINE PESTICIDES			
4,4'-DDD	ug/L	< 0.099	< 0.098
4,4'-DDE	ug/L	< 0.099	< 0.098
4,4'-DDT	ug/L	< 0.099	< 0.098
Aldrin	ug/L	< 0.050	< 0.049
alpha-BHC	ug/L	< 0.050	< 0.049
alpha-Chlordane	ug/L	< 0.050	< 0.049
beta-BHC	ug/L	< 0.050	< 0.049
delta-BHC	ug/L	< 0.050	< 0.049
Dieldrin	ug/L	< 0.099	< 0.098
Endosulfan I	ug/L	< 0.050	< 0.049
Endosulfan II	ug/L	< 0.099	< 0.098
Endosulfan sulfate	ug/L	< 0.099	< 0.098
Endrin	ug/L	< 0.099	< 0.098
Endrin aldehyde	ug/L	< 0.099	< 0.098
Endrin ketone	ug/L	< 0.099	< 0.098
gamma-BHC (Lindane)	ug/L	< 0.050	< 0.049
gamma-Chlordane	ug/L	< 0.050	< 0.049
Heptachlor	ug/L	< 0.050	< 0.049
Heptachlor epoxide	ug/L	< 0.050	< 0.049
Methoxychlor	ug/L	< 0.50	< 0.49
Toxaphene	ug/L	< 5.0	< 4.9
POLYCHLORINATED BIPHENYLS (PCBs)			
Aroclor 1016	ug/L	< 0.99	< 0.98
Aroclor 1221	ug/L	< 0.99	< 0.98
oclor 1232	ug/L	< 0.99	< 0.98
Aroclor 1242	ug/L	< 0.99	< 0.98
Aroclor 1248	ug/L	< 0.99	< 0.98
Aroclor 1254	ug/L	< 0.99	< 0.98

TABLE 3-3
Non-Asbestos Results for Surface Water Samples in the Libby 2 Database

INDEX ID	SAMPLE DATE	SAMPLE LOCATION DESCRIPTION
1R-05329	2-Aug-01	Rainy Creek Rd, Vermiculite Mine -- Lower pond
1R-05330	2-Aug-01	Rainy Creek Rd, Vermiculite Mine -- Upper pond

INDEX ID		**1R-05329**	**1R-05330**
LAB SAMPLE ID		912533-001	912533-002
PARAMETER	UNITS		
Aroclor 1260	ug/L	< 0.99	< 0.98
VOLATILE ORGANIC CHEMICALS (VOCs)			
1,1,1-Trichloroethane	ug/L	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	ug/L	< 1.0	< 1.0
1,1,2-Trichloroethane	ug/L	< 1.0	< 1.0
1,1-Dichloroethane	ug/L	< 1.0	< 1.0
1,1-Dichloroethene	ug/L	< 1.0	< 1.0
1,2-Dichloroethane	ug/L	< 1.0	< 1.0
1,2-Dichloroethene,	ug/L	< 2.0	< 2.0
1,2-Dichloropropane	ug/L	< 1.0	< 1.0
2-Butanone	ug/L	< 5.0	< 5.0
2-Hexanone	ug/L	< 5.0	< 5.0
4-Methyl-2-pentanone	ug/L	< 5.0	< 5.0
Acetone	ug/L	< 5.0	< 5.0
Benzene	ug/L	< 1.0	< 1.0
Bromodichloromethane	ug/L	< 1.0	< 1.0
Bromoform	ug/L	< 1.0	< 1.0
Bromomethane	ug/L	< 2.0	< 2.0
arbon disulfide	ug/L	< 1.0	< 1.0
Carbon tetrachloride	ug/L	< 1.0	< 1.0
Chlorobenzene	ug/L	< 1.0	< 1.0
Chlorodibromomethane	ug/L	< 1.0	< 1.0
Chloroethane	ug/L	< 2.0	< 2.0
Chloroform	ug/L	< 1.0	< 1.0
Chloromethane	ug/L	< 2.0	< 2.0
cis-1,3-Dichloropropene	ug/L	< 1.0	< 1.0
Ethylbenzene	ug/L	< 1.0	< 1.0
Methylene chloride	ug/L	< 1.0	< 1.0
Styrene	ug/L	< 1.0	< 1.0
Tetrachloroethene	ug/L	< 1.0	< 1.0
Toluene	ug/L	< 1.0	< 1.0
trans-1,3-Dichloropropene	ug/L	< 1.0	< 1.0
Trichloroethene	ug/L	< 1.0	< 1.0
Vinyl chloride	ug/L	< 2.0	< 2.0
Xylene, total	ug/L	< 3.0	< 3.0

TABLE 3-4
SEDIMENT ASBESTOS RESULTS IN THE LIBBY 2 DATABASE

Sample Date	Sample ID	Location Description	Analysis Method	Area Fraction (%)		
				Tremolite-Actinolite	Other Amphibole	Chrysotile
8/13/2001	1R-06025	Lower tailings pond at water intake	PLM NIOSH 9002	**ND**	**ND**	**ND**
	1R-05338	Rainy Creek above upper pond	PLM NIOSH 9002	**ND**	**ND**	**ND**
	1R-05340	Upper tailings pond at sleuce gate structure	PLM NIOSH 9002	**2**	**ND**	**ND**

Based on Libby 2DB download performed 7/5/07

Table 3-5
Asbestos Data from Tree Bark

Sample Point	Location, Description	Type of Tree	Amphibole Loading (fiber/cm^2)
*Location 1, Sample 1A	Approx. 100 yards from the former pump house site at the W. R. Grace Vermiculite Mine.	Lodgepole pine	100 million
*Location 1, Sample 1B	Approx. 100 yards from the former pump house site at the W. R. Grace Vermiculite Mine.	Lodgepole pine	260 million
*Location 1, Sample 1D	Approx. 100 yards from the former pump house site at the W. R. Grace Vermiculite Mine.	Larch	40 million
*Location 2	4 mile mark (from bottom of Rainy Creek Rd). Immediately outside of the mine property.	Lodgepole pine	110 million
Location 3, Sample 3B	Approx. 20 yards from the decontamination trailer and access gate for Rainy Creek Rd.	Ponderosa pine	14 million
Location 3, Sample 3C	Approx. 20 yards from the decontamination trailer and access gate for Rainy Creek Rd.	Lodgepole pine	54 million

*Location 1 and 2 samples were collected within the EPA restricted area surrounding the mine site.

Source: Ward et al. (2006)

Table 3-6
Summary of Worker Air Samples from OU3

Location	Activity Description	Sampling Date	LA Detection Frequency	Average Sensitivity $(cc)^{-1}$	Range of LA Detects (s/cc)
Zonolite Mountain	4 samples from site visit	4/26/01	3/4 (75%)	0.0333	0.0631 - 0.147
Forest Service Rd	5 samples excavating logging road	7/29/03 - 7/30/03	0/5 (0%)	0.0300	NA
Rainy Creek Rd	31 samples for driver	5/2/01	1/2 (50%)	0.0529	0.00195
		8/12/02 - 8/26/02	8/9 (89%)	0.0300	0.0147 - 0.824
		7/14/03 - 7/28/03	5/6 (83%)	0.0173	0.151 - 1.30
		6/1/06 - 9/7/06	7/11 (64%)	0.0706	0.0730 - 1.52
		6/1/07	3/3 (100%)	0.0374	0.0470 - 1.53
	22 samples for excavator	5/4/01 - 5/17/01	6/9 (67%)	0.0259	0.0038 - 0.0978
		8/8/02 - 8/15/02	6/7 (86%)	0.0251	0.0352 - 0.245
		9/4/03 - 10/2/03	3/3 (100%)	0.0492	0.0465 - 6.66
		4/20/04	0/3 (0%)	0.0227	NA
	2 samples for foreman	10/22/02 - 10/28/02	0/2 (0%)	0.0894	NA
	12 samples for grader	4/26/01 - 5/15/01	5/7 (71%)	0.0405	0.0113 - 0.154
		8/7/02 - 8/16/02	4/5 (80%)	0.0766	0.0660 - 3.55
	58 samples for laborer	8/7/02 - 9/7/02	25/36 (69%)	0.0351	0.00820 - 4.04
		7/16/03 - 8/19/03	7/7 (100%)	0.0388	0.0719 - 5.37
		4/20/04	0/3 (0%)	0.0612	NA
		7/27/05 - 10/13/06	4/12 (33%)	0.122	0.133 - 0.508
	47 samples for decon activities	8/12/02 - 10/28/02	40/47 (85%)	0.025348426	0.010 - 1.49

NA = not applicable

Based on samples in Libby2DB designated as OU3 (download date: July 5, 2007).

Table 3-7
Summary of Stationary Air Samples from OU3

Location	Location Description	Sampling Date	LA Detection Frequency	Average Sensitivity $(cc)^{-1}$	Range of LA Detects (s/cc)
Zonolite Mountain	83 samples from mine roads and near source areas	5/22/00 - 10/4/00	25/83 (30%)	0.0014	0.00110 - 0.00227
Rainy Creek Rd	104 samples along roadway	3/11/00 - 12/2/00	67/190 (38%)	0.0031	0.000426 - 0.045
	150 samples along roadway	5/4/01 - 9/8/01	81/150 (54%)	0.0022	0.00117 - 0.222
	2 samples downwind of lawn mowing near trace amount	7/11/05	0/2 (0%)	0.00092	NA
Highway 37 N (Right of Way)	10 samples at S of intersection of Pipe Creek Rd & Highway 37 N	5/23/05	0/10 (0%)	0.0042	NA
	2 samples during lawn mowing	7/11/05	0/2 (0%)	0.00092	NA

NA = not applicable

Based on samples in Libby2DB designated as OU3 (download date: July 5, 2007).

Table 3-8
Aquatic Invertebrate Species Collected from EMAP Sampling Location in Kootenai River (August 2002)

PHYLUM	CLASS	ORDER	FAMILY	GENUS	SPECIES	ABUND.
ANNELIDA	HIRUDINEA	RHYNCHOBDELLIDA	PISCICOLIDAE	NA	NA	1
	OLIGOCHAETA	NA	NA	NA	NA	59
ARTHROPODA	ARACHNIDA	TROMBIDIFORMES	HYGROBATIDAE	HYGROBATES	NA	1
			TORRENTICOLIDAE	TORRENTICOLA	NA	3
	INSECTA	DIPTERA	CHIRONOMIDAE	NA	NA	8
				CRICOTOPUS	BICINCTUS	20
				CRICOTOPUS	NA	17
				CRYPTOCHIRONOMUS	NA	1
				DICROTENDIPES	NA	3
				EUKIEFFERIELLA	NA	8
				MICROPSECTRA	NA	16
				NA	NA	85
				PAGASTIA	NA	10
				PARACHIRONOMUS	NA	7
				PARAKIEFFERIELLA	NA	4
				NA	NA	1
				PHAENOPSECTRA	NA	57
				POTTHASTIA	GAEDII	2
				POTTHASTIA	LONGIMANA	7
				PROCLADIUS	NA	1
				PSECTROCLADIUS	NA	1
				SYNORTHOCLADIUS	NA	7
				TANYTARSUS	NA	73
				THIENEMANNIMYIA	NA	7
				TVETENIA	DISCOLORIPES	17
			TIPULIDAE	TIPULA	NA	1
		EPHEMEROPTERA	BAETIDAE	BAETIS	NA	10
				BAETIS	TRICAUDATUS	17
			EPHEMERELLIDAE	DRUNELLA	GRANDIS	1
				EPHEMERELLA	NA	13
				SERRATELLA	TIBIALIS	2
			SIPHLONURIDAE	NA	NA	1
		HEMIPTERA	CORIXIDAE	NA	NA	18
		TRICHOPTERA	HYDROPTILIDAE	HYDROPTILA	NA	3
			LEPTOCERIDAE	MYSTACIDES	ALAFIMBRIATA	1
				OECETIS	NA	1
			LIMNEPHILIDAE	NA	NA	1
				PSYCHOGLYPHA	NA	1
	OSTRACODA	NA	NA	NA	NA	1
COELENTERATA	HYDROZOA	HYDROIDA	HYDRIDAE	HYDRA	NA	12
MOLLUSCA	GASTROPODA	BASOMMATOPHORA	LYMNAEIDAE	NA	NA	1
			LYMNAEIDAE	STAGNICOLA	NA	2
			PHYSIDAE	PHYSA	NA	7
NEMATODA	NA	NA	NA	NA	NA	2

Table 3-9
Fish Species Collected from EMAP Sampling Location in Kootenai River (August 2002)

Common Name	Genus	Species	Abundance
Longnose Dace	*Catostomus*	*catostomus*	24
Largescale Sucker	*Catostomus*	*macrocheilus*	21
Slimy Sculpin	*Cottus*	*cognatus*	1
Torrent Sculpin	*Cottus*	*rhotheus*	2
Cutthroat trout	*Oncorhynchus*	*clarki*	4
Rainbow trout	*Oncorhynchus*	*mykiss*	39
Sockeye Salmon	*Oncorhynchus*	*nerka*	17
Mountain Whitefish	*Prosopium*	*williamsoni*	587
Longnose Dace	*Rhinichthys*	*cataractae*	1
Redside Shiner	*Richardsonius*	*balteatus*	9
Bull Trout	*Salvelinus*	*confluentus*	1